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ANTICIPATORY CUES CAN INTERFERE WITH INHIBITORY OPERANT BEHAVIOR IN THE RAT[1]

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Summary.—In four separate experiments a total of 24 male rats were trained for 30 min. daily in the same temporal order to inhibit their responses for at least 6 sec. before a response-contingent reward was delivered (DRL-6 sec.). The rats tested as the second group each day displayed about twice the number of errors (effect size = 40%) shown by rats tested in the first or third groups. These results suggest that anticipatory cues, acquired within two sessions, interfere with response inhibition during an appetitive task for a limited time (between a few minutes to about one hour). The results are consistent with the hypothesis that learned anticipation of reward may decrease inhibitory mechanisms by facilitating limbic lability.

Serial stimuli can serve as anticipatory cues. Fixed presentations of serial stimuli can synchronize physiological states. For example, food presented regularly can synchronize and amplify the concentration of circulating corticosterone in the rat (Mistlberger & Rusak, 1988). Persinger (1995) employed a similar strategy to evoke conditioned overt limbic seizures in response to daily food presentations in populations of chronically epileptic rats who were maintained on food and water *ad libitum*. The results were consistent with the hypothesis that the amygdalohypothalamic corticotrophin system, which modulates the release of adrenocorticotrophic hormone and subsequently corticosteroids from the adrenal cortex, was extremely sensitive to temporal cuing.

The temporal window within which the consequences of anticipatory conditioning are most effective was estimated to be about 30 min. for the precipitation of overt seizures (Persinger, 1995). To test the generalizability of this temporal range, the following experiment was designed. Casual observation of rats within home cages during daily training indicated rats tested later in a sequence displayed more overt activity as defined by movement in the cage. To discern whether anticipatory cues might interfere with operant performance 24 100 day-old Wistar male rats were trained and tested in four experiments. The duration of each experiment was 10 days, and experiments were separated by about one month.

In each experiment six rats were reduced to 85% body weight over a 1-wk. period. During continuous reinforcement training, the same pairs of

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rats were tested at any given time. During the first three days each rat was placed in a standard operant box that was prepared for shaping. The criterion for each day was 50 responses and rewards (50-mg Noyes pellet).

From Day 4 to Day 10 (seven sessions), pairs of rats were exposed to a DRL-6 sec. interval whereby a minimum of 6 sec. of no responding was required before a response-contingent reward was delivered. The duration of each session was 30 min. Each day the three pairs of rats were tested in the same order. The numbers of response per reward was selected as the dependent variable. This variable was analyzed by three-way analysis of variance (one level repeated) and two levels not repeated: order, i.e., first, second or third, and replication (four experiments) by SPSS software.

The results indicated a statistically significant main effect ($F_{2,12}=4.69$, $p<.05$; partial $\eta^2=44\%$) between the temporal order of testing but no statistically significant differences between experiments ($F_{3,12}=2.82$, $p>.05$). There was no significant interaction between experiment and order ($F_{6,12}<1.00$). In addition to the obvious day (learning) effect ($F_{6,72}=9.81$, $p<.001$; partial $\eta^2=45\%$), there was also a statistically significant interaction between order of testing and day of testing ($F_{12,72}=3.79$, $p<.001$; partial $\eta^2=39\%$). None of the other interactions were statistically significant.

The means and standard deviations for the response:reward ratios for all seven days for the groups tested first, second, or third were 2.0 (0.4), 2.9 (0.6), and 2.4 (0.6), respectively. *Post hoc* analysis (Scheffé's set at $p<.05$ for each day and correlated t tests for each group, i.e., test order, analyzed separately) indicated that the source of the interaction between run order and days was primarily for the first day of DRL training. The means and standard deviations for the response:reward ratios for the groups tested first, second, and third were 2.1 (0.6), 4.4 (1.5), and 2.9 (1.3). The group tested 35 min. to 65 min. after the beginning of the daily session displayed less inhibition relative to those that were tested during the first 30 min. or those tested about 70 min. to 100 min. later. The effect was still marginally significant ($0.05<p<.10$) during the second, third, and fourth days of DRL training (η^2 values of about 22%) but not discernable during the last three days of the experiment.

These results are consistent with the hypothesis that learned sequences of stimuli, including social or environmental cues, can synchronize or trigger internal changes that are sufficient to interfere with the inhibition of overt behavior. For limbic epileptic rats (which were not tested in this study) this disinhibition might be displayed as more frequent overt paroxysmal behaviours (rearing and rapid forepaw clonus). Such behavior has been observed (Persinger, 1995). The habituation of the effect over trials in the present study is consistent with a learning model; however, if rats are labile, kindling rather than habituation might be expected.

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